Cellulose based polyelectrolytes as flocculation agents in wastewater treatment

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Introduction

Modified cellulosic wastes, from paper mills or other wood wastes from various industries are becoming more and more a promising alternative to conventional, harsh to the environment and health, synthetic flocculation agents. Natural cellulosic polyelectrolytes (PEL) through their environmental friendly behaviour, easy accessibility and biodegradability, can be considered as very hopeful attractive molecules for potential flocculation application, namely for wastewater treatment including decolouration of effluents from textile industries [1].

Experimental and Results

Bio-flocculants were obtained starting from the surplus eucalyptus fibres wastes from a pulp mill. Applying a two-step procedure led to obtain cellulose based PELs. First stage includes alkaline extraction in order to separate cellulose from other components. The alkaline extractives from eucalyptus fibres wastes were characterised by HPLC and FTIR. Cationic bio PELs were achieved by the introduction of ammonium groups to the cellulose backbone. Poor cellulose reactivity was solved by decreasing crystallinity of the chain through grinding, and by the introduction of reactive aldehyde groups to the backbone (oxidation of the cellulose hydroxyl groups). The cationic ammonium modified cellulose was produced with different degrees of substitution by changing the stoichiometry between aldehyde content in pre-modified cellulose and the ammonium transfer agent. The cationic ammonium modified cellulose with different degree of substitution was characterised by: FTIR, 1H NMR, EA (elemental analysis), SEC (size exclusion chromatography), DLS (dynamic light scattering for hydrodynamic radius evaluation) and SLS (static light scattering for molecular weight evaluation). Zeta potential of the water soluble PEL was measured by Electrophoretic Light Scattering. The obtained PEL were evaluated on flocculation, using as model effluents kaolin, calcium carbonate suspensions, and several coloured effluents in order to evaluate their decolouration performance. The efficiency of the removal process was evaluated by measuring the absorbance of the supernatant water, and removal percentage was calculated.

The flocculation performance of bio-PEL in a dual system on Methylene blue effluent is illustrated in Fig.1. Using 2.1ppm of cationic cellulose and 0.07% of bentonite on model waste water that contained 5mg/L of dye led to remove up to 98% of colour measured by UV-spectroscopy.

Conclusions

Cationic cellulosic derivatives proved to be efficient biopolymeric flocculation agents for the tested model waters such as kaolin, calcium carbonate suspensions or even for colour removal in decolouration processes. The produced eco-friendly flocculants present a high potential for the treatment of coloured effluents and can be considered as an alternative to synthetic flocculation agents.

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